



Impacts of Chilling Duration on Marbling Score, Shrinkage, and Lean Color in Beef Carcasses

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Objectives

This study was aimed to determine the effects of chilling duration on marbling score, shrinkage, and lean color of beef carcasses.

Materials and Methods

Ten beef carcasses of USDA Choice to Prime were selected at a commercial beef processing facility, randomly ribbed on either left or right side at 24 h, and evaluated repeatedly by a USDA grader at 24, 48, 72, and 96 h for quality grade, yield grade, and marbling score. Carcasses were hung in a cooler at 0 to 3°C, 3.1 m/s of wind speed, and 153 lux of fluorescent light. Ribeye temperature was recorded on both ribbed and un-ribbed sides of a carcass. Marbling score was converted to a numerical scale (200 = Practically Devoid⁰⁰, 300 = Traces⁰⁰, 400 = Slight⁰⁰, 500 = Small⁰⁰, 600 = Modest⁰⁰, 700 = Moderate⁰⁰, 800 = Slightly Abundant⁰⁰, 900 = Moderately Abundant⁰⁰, 1000 = Abundant⁰⁰). Hot carcass weight and daily cold carcass weight were recorded to calculate shrinkage. Lean color (L*, a*, and b*), surface reflectance spectra (400 to 700 nm), and pH were recorded only at 72 and 96 h. Surface deoxymyoglobin, oxymyoglobin, and metmyoglobin percentages were calculated using the reflectance spectra according to AMSA guidelines. Statistical analysis was performed by the GLIMMIX and the PANEL procedures of SAS 9.4 (SAS Institute Inc., Cary, NC). Actual probability values were reported.

Results

At 24 h, in both ribbed and un-ribbed sides, ribeye temperature reached 2.7 to 3.3°C after 24-h chilling and all carcasses were graded with marbling score ranging from 620 to 800 (mean = 710; standard deviation = 73). Compared with 24 h, marbling score did not change at 48 h ($P = 0.443$) but was increased by 10 points at 72 h ($P = 0.023$) and by 21 points at 96 h ($P = 0.014$). Carcass weight was increased by 0.6% by 48 h, 1.1% by 72 h, and 0.4% by 96 h ($P \leq 0.007$) compared with 24 h; however, such an increase was caused by a malfunction of the spray-chill system, which continuously sprayed the carcasses for 96 h instead of intermittently for 24 h. The L* value (lightness) was increased from 40.2 to 43.4 ($P = 0.014$) and so were surface metmyoglobin and deoxymyoglobin by 1% from 72 to 96 h ($P = 0.035$ and 0.0121 , respectively); however, such a small increase has no biological significance. The pH value remained constant at 5.6 from 72 to 96 h. The regression analysis by the PANEL procedure indicated that the marbling score in this dataset could be predicted by chilling time, as follow: marbling score = $740 + 0.3 \times \text{time (h)}$ ($R^2 = 0.98$; $P < 0.001$ for both the intercept and slope).

Conclusion

The findings suggest that 96-h chilling increases marbling score of beef carcasses and such an increase (20 points) can potentially allow the carcasses borderline on a higher grade to be graded higher without negatively affecting shrinkage, lean color, and pH.